Maternal age and primary cesarean section rates: A multivariate analysis

Michelle Martel, M.D., Sholom Wacholder, Ph.D., Abby Lippman, Ph.D., John Brohan, B.Sc., and Emily Hamilton, M.D.C.M.
Montreal, Quebec, Canada

To study the effect of maternal age on primary cesarean section rates, 3458 consecutive deliveries were analyzed. The cesarean section rates in primiparous women less than 25, 25 to 34, and over 34 years of age were 13.1%, 18.5%, and 28.2%, respectively. A similarly dramatic rise with advancing maternal age was seen in multiparous women with rates of 3.4%, 4.7%, and 10.1%, respectively, in the three age groups. The strong association between cesarean section and maternal age persisted after multivariate adjustment for induction of labor, epidural anesthesia, meconium-stained amniotic fluid, and fetal distress, and thus these factors do not explain the relationship. (AM J OBSTET GYNECOL 1987;156:305-8.)

Key words: Cesarean section, primary; maternal age

Cesarean section rates have been increasing steadily in Canada, from 6.0% in 1970 to 17.1% in 1983.[1] Little consensus exists on the reasons for this increase. One suggestion has been that the increasing age of the obstetric population contributes to this trend.[2,3] Wadhera and Nair[1] reported a steady rise in the total cesarean section rate with maternal age. Nevertheless, because age-related primary rates are not available and because repeat cesarean sections, which would be more frequent among older women, are not excluded from most statistical summaries, the precise relationship between maternal age and cesarean section rates is unknown and explanations of it can only be speculative. This study was designed to analyze directly the effects of maternal age on primary cesarean section rates, taking into consideration other factors that might vary with maternal age.

Material and methods

All deliveries at the Sir Mortimer B. Davis Jewish General Hospital in Montreal, occurring from April 1984 to August 1985, were reviewed. After exclusion of those that were complicated by multiple gestation, stillbirth, placenta previa, or breech presentation and those in which cesarean section was performed because of a previous cesarean section, 3458 deliveries remained for analysis. These were grouped into three maternal age categories and according to whether the woman was primiparous or multiparous.

For each of the deliveries, information on the presence or absence of meconium, induction of labor, epidural anesthesia, fetal distress, maternal diabetes, hypertension, 1-minute Apgar scores, and birth weight was taken from the computerized delivery record completed at the time of delivery.

Various clinical methods are used to assess fetal health. Electronic monitoring of fetal heart rate was done in all patients in whom the diagnosis of fetal distress was made. Fetal scalp blood or cord blood samples were only rarely available. The antepartum diagnosis of fetal distress was made if there were persistent decelerations that may have been associated with changes in variability of the baseline fetal heart rate. Decreased variability alone was not considered fetal distress. The category of hypertension included all cases of hypertension requiring treatment and those in which the blood pressure was persistently >140/90 mm Hg in labor. The 1- and 5-minute Apgar scores were used to assess infants in whom the diagnosis of fetal distress was made. Because all cesarean sections for fetal distress were attended by neonatal staff, it was considered that the 5-minute Apgar scores would be influenced by resuscitation efforts and would mask the effect of fetal distress.

Analyses were performed separately for primiparous and multiparous women. Crude odds ratios were used as a preliminary measure of the association between maternal age and cesarean section. Because other factors related to maternal age and cesarean section could distort the association between these two variables, we carried out a multivariate logistic regression analysis wherein the dependent variable was presence or ab-

From the Department of Obstetrics and Gynecology, Sir Mortimer B. Davis Jewish General Hospital, and the Department of Epidemiology and Biostatistics, Faculty of Medicine, and the School of Computer Science, McGill University.
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Reprint requests: Dr. E. Hamilton, Sir Mortimer B. Davis Jewish General Hospital, 3755 Cote Ste. Catherine Road, Montreal, Quebec, Canada H3T 1E2.

Table I. Primary cesarean section rates in the various age and parity groups

	Maternal age					
	≤24 yr		*25 to 34 yr*		*≥35 yr*	
	Total No.	*Cesarean section (%)*	*Total No.*	*Cesarean section (%)*	*Total No.*	*Cesarean section (%)*
Primiparous women	602	13.1	1017	18.5	99	28.2
Multiparous women	261	3.4	1201	4.7	278	10.1

Table II. Frequency of obstetric factors related to cesarean section

	Maternal age					
	≤24 yr		*25 to 34 yr*		*≥35 yr*	
Obstetric factor	*Primiparous women (N = 602)*	*Multiparous women (N = 261)*	*Primiparous women (N = 1017)*	*Multiparous women (N = 1201)*	*Primiparous women (N = 99)*	*Multiparous women (N = 278)*
Induction of labor	13.9	6.1	15.2	11.8	13.1	11.8
Epidural anesthesia	54.2	21.4	55.6	26.3	51.5	26.2
Meconium	11.9	11.1	12.7	9.0	14.1	13.3
Fetal distress	3.8	1.1	5.0	1.7	8.1	2.2
Diabetes	1.8	0.8	3.0	2.7	6.1	4.3
Hypertension	5.8	1.1	5.6	2.3	7.1	1.4
Macrosomia (>4000 gm)	7.4	8.8	7.3	9.5	5.1	13.7

Frequency expressed as percent.

Table IIIA. Frequency of the three major indications for cesarean section in primiparous women

	Maternal age		
Indication	*≤24 yr*	*25 to 34 yr*	*≥35 yr*
Dystocia	7.1	11.3	11.1
Fetal distress	3.3	4.6	8.1
Preeclampsia	1.3	1.1	3.1

Frequency expressed as percent.

Table IIIB. Frequency of the three major indications for cesarean section in multiparous women

	Maternal age		
Indication	*≤24 yr*	*25 to 34 yr*	*≥35 yr*
Dystocia	0.8	1.6	5.0
Fetal distress	1.1	1.4	1.8
*Abruptio placentae	—	0.2	1.1

Frequency expressed as percent.

sence of cesarean section and the independent variables were meconium staining of the amniotic fluid, induction of labor, epidural anesthesia, and fetal distress.[1] Adjusted odds ratio estimates were obtained from the regression coefficients of the model. These adjusted odds ratio estimates are free from the confounding effects of the other variables in the model. Diabetes and macrosomia were not themselves indications for cesarean section and therefore were not considered as covariates.

To investigate whether different diagnostic standards were applied to older women, we looked at the frequencies of low 1-minute Apgar scores, a marker of fetal distress, in the different age groups. If the diagnosis of fetal distress was applied similarly to women of different ages, the frequency of low 1-minute Apgar scores should be the same in all age groups among women undergoing cesarean section for fetal distress.

Results

Women aged 35 years and older constituted 10.9% of the total population, representing 5.8% of the primiparous women and 16.0% of the multiparous women. The overall cesarean section rate was 11.2% and the rates for each age-parity group are presented in Table I. There was a striking increase in rates in the primiparous women ($\chi^2 = 15.8$, $p < 0.0005$). Cesarean section rates were lower in the multiparous women, but there was still evidence of a significant increase with age ($\chi^2 = 12.2$, $p < 0.0005$).

Table IVA. Crude and adjusted* odds ratio estimates of the association between maternal age and cesarean section in primiparous women

Age (yr)	Crude		Adjusted*	
	Estimate	SE	Estimate	SE
25-34†	1.50	0.22	2.00	0.32
>35†	2.61	0.66	3.56	0.97

*Adjusted for the presence or absence of induction of labor, epidural anesthesia, meconium, and fetal distress.
†Compared with women under 25 years of age.

Table IVB. Crude and adjusted* odds ratio estimates of the association between maternal age and cesarean section in multiparous women

Age (yr)	Crude		Adjusted*	
	Estimate	SE	Estimate	SE
25-34†	1.32	0.48	1.27	0.55
>35†	3.14	1.23	3.49	1.58

*Adjusted for the presence or absence of induction of labor, epidural anesthesia, meconium, and fetal distress.
†Compared with women under 25 years of age.

Table V. Frequency of 1-minute Apgar scores of ≤5 in infants of women having cesarean section for fetal distress

	Maternal age					
	≤24 yr		25 to 34 yr		≥35 yr	
	No.	%	No.	%	No.	%
Primiparous women	5/20	20.0	11/47	23.4	2/8	25.0
Multiparous women	1/3	33.3	4/17	23.5	1/5	20.0

A number of obstetric factors that may be associated directly or indirectly with a higher probability of cesarean section and their distribution according to maternal age are shown in Table II. As can be seen, there were no major differences in the frequencies of induction of labor, epidural anesthesia, or meconium in the various age or parity groups. Although fetal distress appeared to occur more frequently in the oldest age group, its relative rarity suggests that it cannot account for the increasing cesarean section rates.

Rates of dystocia among all of the age groups are presented in Tables IIIA and IIIB. It should be noted that dystocia is poorly defined clinically and the term is generally applied only when a cesarean section is performed. As a result it is not a useful covariate.

Dystocia, fetal distress, preeclampsia, and abruptio placentae were the major indications for cesarean section in this selected study population and their frequencies in the various age groups are shown in Tables IIIA and IIIB. These indications account for 84.5% and 71.0%, respectively, of all the cesarean sections in the primiparous and multiparous women. None of the other indications for cesarean section occurred in more than 2% of the women in this selected population.

Crude and adjusted odds ratios together with their standard errors are found in Tables IVA and IVB. For example, in Table IVA the crude estimate of the odds ratio in women aged 25 to 34 years shows them to be 1.5 times more likely to have a cesarean section than are primiparous women under 25 years of age. When the analysis is done by removing the effects of possibly confounding covariates, these same women are found to be 2.0 times more likely to have a cesarean section than are women under 25 years of age. The age effect is highly significant ($p < 0.0005$) for all of the analyses. The odds ratios are not substantially affected by the inclusion of the adjusting factors, suggesting that these factors alone or in combination do not explain the association between age and cesarean section.

The frequencies of low 1-minute Apgar scores among infants of women having a cesarean section for fetal distress were similar in the three age groups of primiparous and multiparous women (Table V). From this distribution, it would appear that fetal distress is being diagnosed similarly in the older and younger women even though it is more common among the older women.

Comment

Analysis confirms the association between maternal age and cesarean section rates, with dramatic increases seen among both primiparous and multiparous women. Results of multivariate analysis indicate that the increased rates are not an artifact resulting from the effects of the chosen covariates inasmuch as the adjusted rates do not vary substantially from the crude rates. In other words, even after adjustment for the covariates, the strong association between maternal age and cesarean section persists.

This analysis was restricted to variables available rou-

tinely from the delivery record. It is possible that unmeasured factors could explain the age and cesarean section association. These factors could include socioeconomic status, parental anxiety, or previous infertility, for example. It is unlikely, however, that they would include medical factors, since these would be subsumed in the chosen covariates.

It may also be that the increased rate in older women results from physician beliefs that this group is at increased risk for labor complications and that cesarean section can circumvent these problems. This is in agreement with the observations of Kirz et al.[5] More needs to be learned about how physicians make management decisions and whether these decisions are the most appropriate for older women.

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Prenatal diagnosis and management of congenital defects of the anterior abdominal wall

M. Sermer, M.D., R. J. Benzie, M.D., L. Pitson, M.D., M. Carr, M.D., and M. Skidmore, M.D.

Toronto, Ontario, Canada

Between the years 1980 and 1985, 25 cases of anterior abdominal wall defects were identified within the University of Toronto Perinatal Complex. There were 17 cases of omphalocele and eight cases of gastroschisis. Associated anomalies were found in 71% of infants with omphalocele and 50% with gastroschisis. They were the major cause of neonatal death. Prematurity was the second most common cause of death. The neonatal death rate was 59% in omphalocele and 38% in gastroschisis; the prematurity rates were 53% and 50%, respectively. In omphalocele, there was a 47% cesarean section rate, with a 50% neonatal death rate. Vaginal delivery was associated with a 67% death rate. In gastroschisis, there was a 50% cesarean section rate, with a 50% neonatal death rate. Vaginal delivery was associated with a 25% death rate. There is no evidence that cesarean section offers improved neonatal survival. (Am J Obstet Gynecol 1987;156:308-12.)

Key words: Omphalocele, gastroschisis, prenatal diagnosis, ultrasound

The incidence of omphalocele is in the order of one in 4000 to one in 5000 live births, while that of gastroschisis is about one in 10,000 to one in 12,000 live births.[1, 2] Even though the incidence is relatively low, increased neonatal survival in the past decade has resulted in greater attention being paid to these congenital abnormalities.

These increased survival rates are secondary to advances within neonatal intensive care units, improvement in intravenous nutrition, better infection control, and development of new surgical techniques. For this reason, greater attention must be paid to the antenatal diagnosis, counseling, and management of these conditions.

Omphalocele is a defect of the umbilical ring and medial segments of the two embryonic lateral abdmonal wall folds. A sac is present into which intra-abdominal, and occasionally intrathoracic, contents may herniate. The inner layer of the sac consists of peritoneum and the outer layer consists of amnion. The umbilical cord insertion arises from the sac.

Gastroschisis is characterized by intestinal herniation through a defect in the anterior abdominal wall. This defect is usually to the right of the umbilicus. The um-

From the University of Toronto Perinatal Complex, Women's College Hospital, Toronto General Hospital.
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Reprint requests: Dr. M. Sermer, Department of Obstetrics and Gynaecology, Toronto General Hospital, 101 College St., Toronto, Ontario, Canada.